CHAPTER II

RECONNAISSANCE

A. GENERAL

Land station and ship reports continue to be scarce in areas of tropical cyclone formation. The tropical cyclone warning system depends upon aircraft reconnaissance data to fix the location and strength of tropical cyclones. Only on rare occasions are land radar fixes or sequential reports available to compare with reconnaissance data. Increased satellite coverage during 1969 proved to be an invaluable aid in scheduling aircraft reconnaissance to achieve maximum effectiveness. Interpretation of storm intensity and center location from satellite pictures only is presently not sufficiently reliable for operational use. Continuous surveillance of tropical cyclones is of the utmost importance as illustrated by the explosive deepening of typhoon Kathy on November 6 from a system requiring great skill and persistence to locate in the afternoon to a nighttime reconnaissance indication of 60 knots only 12 hours later.

Four fixes per day were scheduled on all tropical cyclones following the initial fix which was normally coordinated with the earliest availability of reconnaissance aircraft on the scene. As a general rule VW-1 made fixes at 0900Z and 1500Z at low and intermediate levels and 54WRS made fixes at 2100Z and 0300Z at intermediate (700 mb) level. High level (500 mb) fixes were made on storms in the vicinity of higher terrain. Most storms were taken into warning on the basis of daylight investigative flight data.

B. RECONNAISSANCE RESPONSIBILITY

Squadrons responding to the reconnaissance requirements of JTWC through the TCRC in 1969 were U. S. Air Force 54th Weather Reconnaissance Squadron (54WRS) flying WC-130 aircraft from Andersen Air Force Base, Guam and the U. S. Navy Airborne Early Warning Squadron ONE (VW-1) flying WC 121N aircraft from the Naval Air Station, Agana, Guam.

C. EVALUATION OF DATA

Eye data from tropical cyclones is provided by low level penetration, intermediate level penetration or radar fixes from outside the center. Penetration data provides the best quality data including dropsonde soundings, minimum 700 mb height and sea level pressure, maximum observed wind (estimated), shape and character of the eye and feeder band information. The primary center of the cyclone is based on the location of minimum pressure at the surface, a parameter best obtained by low level penetration, however the nearly vertical structure of most tropical cyclones promises only slight loss of accuracy on intermediate penetration fixes. Radar fixes made outside the center introduce an attenuation and radar accuracy error not present in penetration fixes. Radar fixes are also based on the radar center rather than the pressure center of the storm. Not infrequently reports of centers determined independently by

wind, clouds, pressure and temperature will vary by 10 miles or more. The eye report contains a subjective estimate of fix accuracy which must also be taken into account in the determination of the storm location at warning time. A final factor in this determination is the forecasters ability to accurately forecast the direction and speed of movement of the storm. On a statistical basis this error rate is 4 to 5 miles per hour of forecast time. During 1969 the mean difference between the post analysis warning position and the published operational warning position was 20.7 N.M. Since the mean time difference from fix to warning time is two hours the forecast error contribution is 9 to 10 miles leaving a residual value of 11 N.M. attributed to the mean accuracy of reconnaissance fixes.

Short term variability in the actual cyclone track and the mean amount of "smoothing" incorporated in the best track analysis are subjective factors included within the 11 N.M. accuracy accorded reconnaissance fixes in operation use.

Maximum differences between warning positions and best track positions resulted when reconnaissance was not continuously maintained, when the developing storm has an indistinct and shifting center or when fix positions used for the warning position fell well outside the past season best track analysis.

D. COMMUNICATIONS

The primary means of communication between JTWC and reconnaissance aircraft was voice single sideband through Andersen Airways (AIE 2) serving as the primary air to ground station for both 54WRS and VW-1 weather missions. Secondary air to ground stations were Clark AFB, Fuchu Airways and Kadena Airways. When secondary ground stations were used eye data was passed to JTWC via the Joint Overseas Switch (JOSS). Eye data messages received by Andersen Airways were simultaneously received at JTWC by direct phone patch. A hard copy backup message was transmitted from Andersen over local teletype circuit SDE 9.

Average delay time from time of fix to receipt in JTWC by phone patch was 20 minutes including message preparation time in the aircraft and time to copy the message in JTWC. Maximum delay time by phone patch was 1 hour 21 minutes and minimum delay just a few minutes. Direct communications with reconnaissance aircraft permitted direction of aircraft on synoptic missions into areas of suspicion appearing on satellite.

E. SUMMARY OF RECONNAISSANCE SUPPORT

A reconnaissance fix accreditation system was devised in 1965 in an effort to establish an objective evaluation of reconnaissance effectiveness. The system has been in use with minor modifications since that time.

Fix times are scheduled as near as possible to warning time to still permit receipt of the data for consideration by JTWC

forecasters before release of the official warning. Prior to 1967 it was necessary to schedule fixes three hours before warning time. Improved communications in 1967 made it possible to schedule fixes only two hours before warning time.

AIRCRAFT RECONNAISSANCE DATA

(NUMBER OF FIXES AND INVESTIGATIONS)

1961	1962	1963	1964	1965	1966	1967	1968	1969
350	496	465	772	666	674	845	807	468*

*76 preliminary or intermediate (No Credit) fixes not included.

In addition there were 203 synoptic tracks flown in 1969.

TABLE 2-1

DELAY IN RECEIPT OF RECONNAISSANCE FIX DATA FOR 1969

METHOD	NUMBER OF CASES*	MAX DELAY TIME	MIN DELAY TIME	AVG DELAY TIME
PHONE PATCH	402	1 HR 21 MIN	0 HR 01 MIN	0 HR 20 MIN
SDE 9	49	2 HR 11 MIN	0 HR 10 MIN	0 HR 33 MIN
OTHER	33	1 HR 57 MIN	0 HR 10 MIN	0 HR 30 MIN

*Does not include 60 fixes made on cyclones that did not develop.

TABLE 2-2

COMPARISON OF DELAY TIMES WITH PREVIOUS YEARS

	1965	1966	1967	1968	1969
MAX DELAY TIME	60 HR 09 MIN	4 HR 33 MIN	11 HR 20 MIN	6 HR 25 MIN	2 HR 11 MIN
AVG DELAY TIME	1 HR 05 MIN	1 HR 02 MIN	0 HR 43 MIN	0 HR 25 MIN	0 HR 22 MIN
MIN DELAY TIME	0 HR 09 MIN	FEW MINUTES	FEW MINUTES	FEW MINUTES	0 HR 01 MIN
PERCENT OF EYE MESSAGES DELAYED MORE THAN 1 HR	39%	38%	16%	4%	2.8%
NUMBER OF FIXES RECEIVED AFTER WARNING TIME	34	30	23*	6*	3*
PERCENT OF FIXES RECEIVED AFTER WARNING TIME	5.7%	5.4%	3.1%	0.7%	0.6%

*Since 1967, fixes scheduled 2 hours prior to warning time vice 3 hours prior to warning time during previous years.

TABLE 2-3

DEFINITION OF FIX CREDITS AND EVALUATION OF TIMELINESS OF RECONNAISSANCE FOR 1969

CLASS	DEFINITION		1969
1	FULL CREDIT	From 1 hour before to 1/2 hour after levied time.	360
2	FULL CREDIT	Aircraft in assigned area within 1 hour before to 1/2 hour after levied time but unable to locate a center.	14
3	EARLY/LATE	Center located 1 to 1 1/2 hours before or 1/2 to 2 hours after levied time.	10
4	VERY EARLY/ VERY LATE	Greater than 1 1/2 hours before or more than 2 hours after levied time.	3
5	ATTEMPTED BUT MISSED FIX	Recon provided some useful peripheral data but no fix was made. Reasons may include clearance problems, mechanical trouble, low fuel, etc.	0
6	MISSED FIX	Missed fixes not falling into any category above.	6
7	FULL CREDIT	Fix made on investigative flight or synoptic track.	32
8	FULL CREDIT	Investigative flight, no fix made.	49
9	NO CREDIT	Preliminary or intermediate fix made between scheduled fixes.	76

TABLE 2-4